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Southwestern
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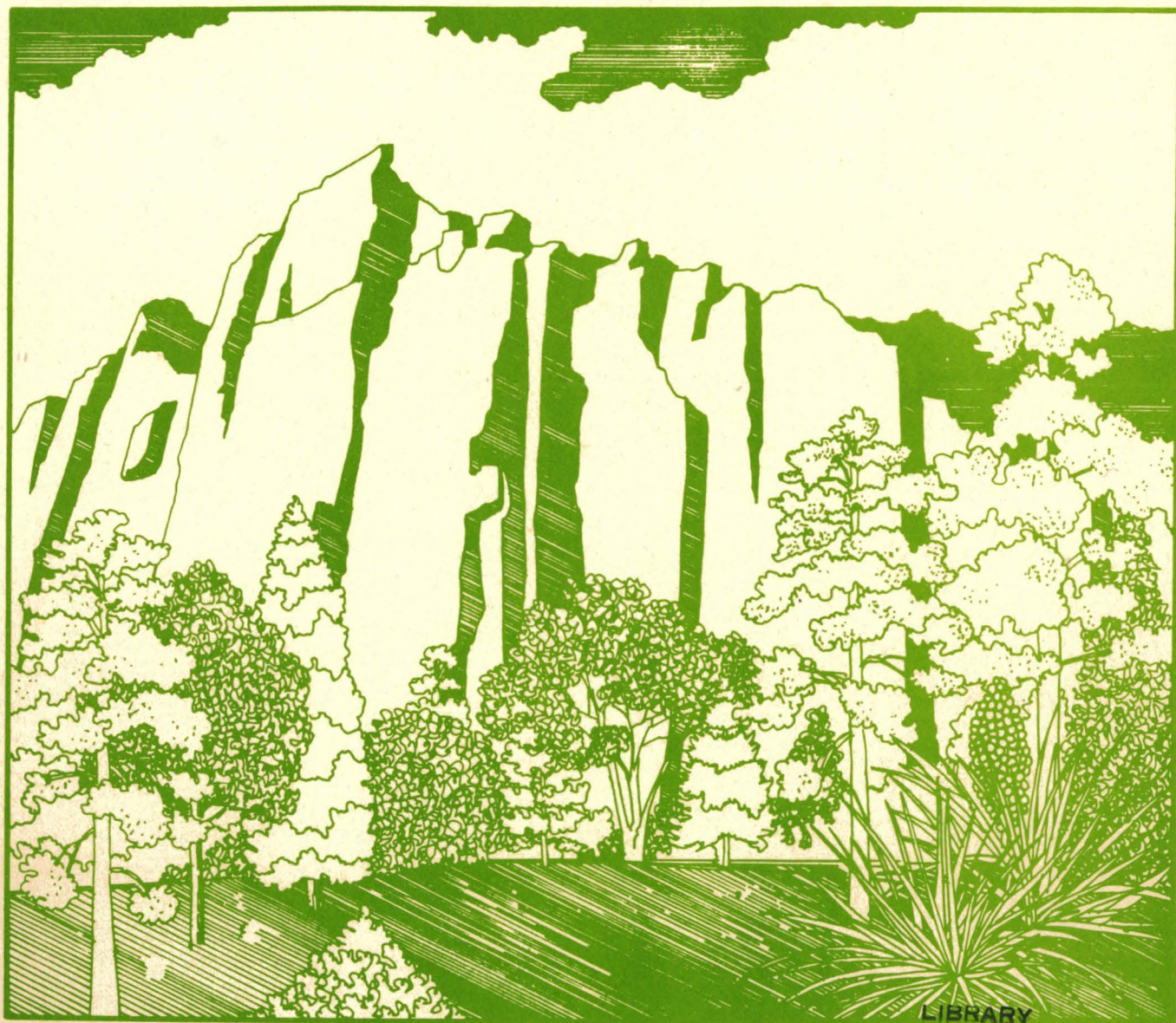
Forest Pest Management Report

R-3 86-1

BIOLOGICAL EVALUATION
Effects of Soil Fumigation on
Soilborne Plant Pathogens and Seedlings
at the Albuquerque Tree Nursery

Cibola National Forest
New Mexico

October 1985



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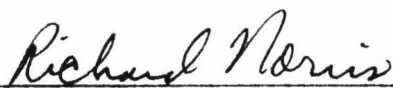
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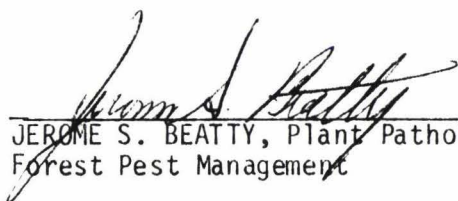
USDA Forest Service, Southwestern Region
State and Private Forestry
Forest Pest Management
517 Gold Avenue, SW
Albuquerque, New Mexico 87102

PREPARED BY:

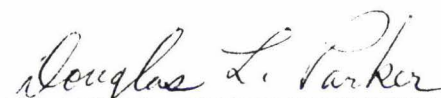

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SUMMARY

The Albuquerque Tree Nursery (ATN) annually fumigates seedbeds with methyl bromide and chloropicrin at an average rate of 350 pounds per acre for the purpose of suppressing potential soilborne plant pathogens, weeds, and nematodes. Since 1979, Forest Pest Management has evaluated the effectiveness of the annual fumigation in reducing population levels of various species of Fusarium and Pythium.

Blocks 7 and 8 were fumigated during the week of June 24-28, 1985, using the alternate strip method. Prefumigation Fusarium spp. population levels averaged 6,000 and 3,500 propagules per gram (ppg) in blocks 7 and 8, respectively. Fusarium levels were reduced significantly after fumigation; 27 ppg in block 7 and 0 ppg in block 8. Pythium spp. population levels were low before fumigation, 1 ppg in both blocks 7 and 8, and were reduced to 0 ppg in both blocks (tables 1 and 2). Seedling survival was significantly lower in the unfumigated plots than in the fumigated areas (tables 3 and 4).

Table 5 illustrates the pre- and post-fumigation population levels of Fusarium spp. and Pythium spp. from 1979 through 1985.

METHODS

Prefumigation soil sampling was conducted in blocks 7 and 8 on June 17, 1985, specifically to assay species of Fusarium and Pythium. Sections 4 through 9 of block 7, and sections 14 through 17 of block 8, were sampled by walking the length of each section and inserting a soil core extractor 4 to 6 inches into the soil at 20-foot intervals. Collected soil cores were mixed and each was placed in a separate bag labeled with the appropriate section number and collection date. Fusarium and Pythium spp. isolations were performed using standard soil dilution plating techniques and selective media for Fusarium and Pythium spp. (refer to Biological Evaluation R-3 83-10). Postfumigation soil sampling was conducted on July 8, 1985, and end-of-season soil sampling was conducted on September 23, 1985, in blocks 7 and 8 using the same techniques.

Fumigation effects on seedling survival were determined by establishing two unfumigated plots in block 7 and two plots in block 8. In the selected sections (section 6 in block 7 and section 16 in block 8), the fumigation crew was instructed to establish plots, each 16 feet by 24 feet. The plots in block 7 were 90 feet and 240 feet from the northern edge of the block, and the plots in block 8 were 120 feet and 245 feet from the northern edge of the block. Corners of the unfumigated plots were marked with flagging. Areas immediately adjacent to the unfumigated plots served as fumigated plots.

Seedling density estimates, comparing fumigated with unfumigated areas, were made by placing a 1- by 4-foot frame across each bed in the selected sections, and counting the live seedlings contained therein. Estimates were made on August 12, 1985, at the beginning of the growing season, and on October 2, 1985, at the end of the growing season.

RESULTS AND DISCUSSION

Prefumigation soil sampling in block 8 showed that levels of Fusarium averaged 6,000 ppg in block 7 and 3,500 in block 8. Blocks 7 and 8 were fumigated during the first week of June 24 through 28, and postfumigation soil sampling indicated that the Fusarium population level was significantly reduced (27 ppg in block 7 and 0 ppg in block 8). Propagule density had increased by the end of the growing season to 33 ppg in block 7 and to 100 ppg in block 8 (tables 1 and 2 and figures 1 and 2).

Pythium spp. were found to be at a low level before fumigation (1 ppg in block 7 and 1 ppg in block 8) and were reduced to 0 ppg in both blocks. At the end of the growing season, Pythium population levels rose to an average 7 ppg in block 7 and <1 ppg in block 8 (tables 1 and 2 and figures 1 and 2).

Blocks 7 and 8 were sown to provide 40 viable seedlings per square foot. Seedling density was higher in fumigated soils than in unfumigated soils. Unfumigated soils yielded 26 seedlings per square foot and 21 seedlings per square foot on August 12, 1985, in blocks 7 and 8, respectively, as opposed to 37 and 38 seedlings per square foot in fumigated soils. Similarly, on October 2, 1985, seedling counts were 25 and 20 in unfumigated soils and 38 and 40 in fumigated soils in blocks 7 and 8, respectively (tables 3 and 4 and figures 3 and 4).

CONCLUSIONS AND RECOMMENDATIONS

The benefits gained from fumigation of blocks 7 and 8, namely the reduction of Fusarium population levels and the higher seedling survival rate, more than justify the expense of fumigation (refer to Biological Evaluation R-3 83-10) and seedbed fumigation should continue at the present levels.

TABLE 1.--Means and standard errors of Fusarium and Pythium populations
(block 7, sections 4 through 9)

	<u>Fusarium spp.</u>		<u>Pythium spp.</u>	
	$\bar{x}$	$s\bar{x}$	$\bar{x}$	$s\bar{x}$
Prefumigation	6,000	822	1	0
Postfumigation	27	27	0	0
End of season	33	33	7	7

TABLE 2.--Means and standard errors of Fusarium and Pythium populations
(block 8, sections 14 through 7)

	<u>Fusarium</u>		<u>Pythium</u>	
	$\bar{x}$	$s\bar{x}$	$\bar{x}$	$s\bar{x}$
Prefumigation	3,500	457	1	1
Postfumigation	0	0	0	0
End of season	100	64	0	0

TABLE 3.--Means and standard errors of seedling densities (trees
per square foot) (block 7, section 6)

		$\bar{x}$	$s\bar{x}$
August	Unfumigated	26	2
	Fumigated	37	1
October	Unfumigated	25	1
	Fumigated	38	1

TABLE 4.--Means and standard errors of seedling densities (trees
per square foot) (block 8, section 16)

		$\bar{x}$	$s\bar{x}$
August	Unfumigated	21	3
	Fumigated	38	1
October	Unfumigated	20	1
	Fumigated	40	3

TABLE 5.--Pre- and post-fumigation population levels of Fusarium and Pythium (1979-85) (propagules per gram)

<u>1979</u>		<u>Pre</u>	<u>Post</u>
Block 3	<u>Fusarium</u> <u>Pythium</u>	20,190 8	9,328 5
Block 4	<u>Fusarium</u> <u>Pythium</u>	6,162 13	10,060 6
<u>1980</u>			
Blocks 3 & 4	<u>Fusarium</u> <u>Pythium</u>	4,240 12	1,829 1
<u>1981</u>			
Block 1	<u>Fusarium</u> <u>Pythium</u>	1,543 6	53.33 1
<u>1982</u>			
Block 7	<u>Fusarium</u> <u>Pythium</u>	2,698 2	149 1
Block 8	<u>Fusarium</u> <u>Pythium</u>	1,584 3	47 1
<u>1983</u>			
Block 5	<u>Fusarium</u> <u>Pythium</u>	2,952 2	66.67 0
Block 1	<u>Fusarium</u> <u>Pythium</u>	6,033 --	133 --

TABLE 5.--Pre- and post-fumigation population levels of Fusarium and Pythium (1979-85) (propagules per gram)--continued

<u>1984</u>		<u>Pre</u>	<u>Post</u>
Block 8	<u>Fusarium</u>	400	111
	<u>Pythium</u>	4	1
Blocks 1 & 2	<u>Fusarium</u>	4,633	33
	<u>Pythium</u>	1	0
<u>1985</u>			
Block 7	<u>Fusarium</u>	6,000	27
	<u>Pythium</u>	1	0
Block 8	<u>Fusarium</u>	3,500	0
	<u>Pythium</u>	0	0

Figure 1. MEAN POPULATIONS OF FUSARIUM & PYTHIUM
AT THE ALBUQUERQUE TREE NURSERY

Block 7

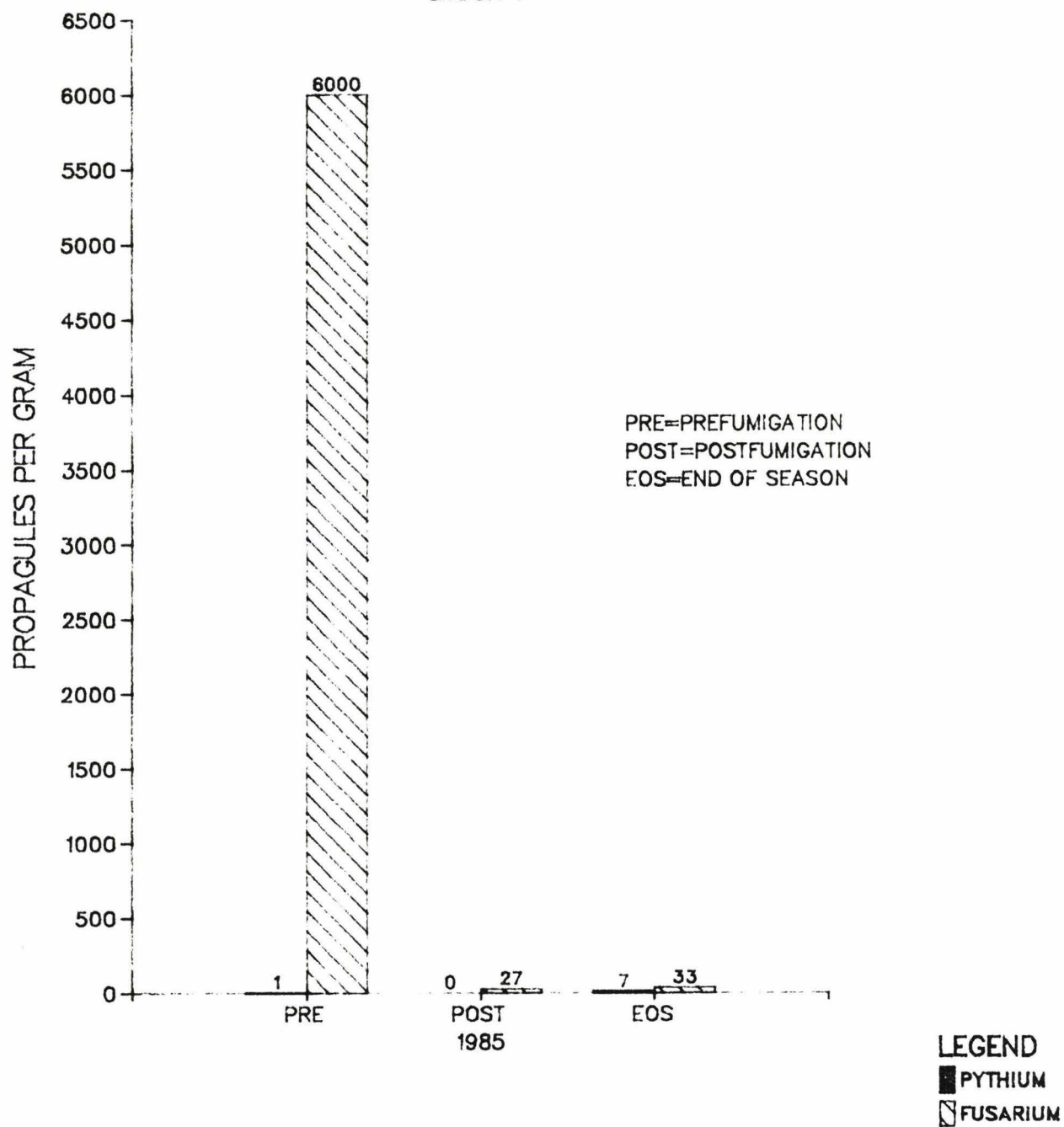


Figure 2. MEAN POPULATIONS OF FUSARIUM & PYTHIUM
AT THE ALBUQUERQUE TREE NURSERY

Block 8

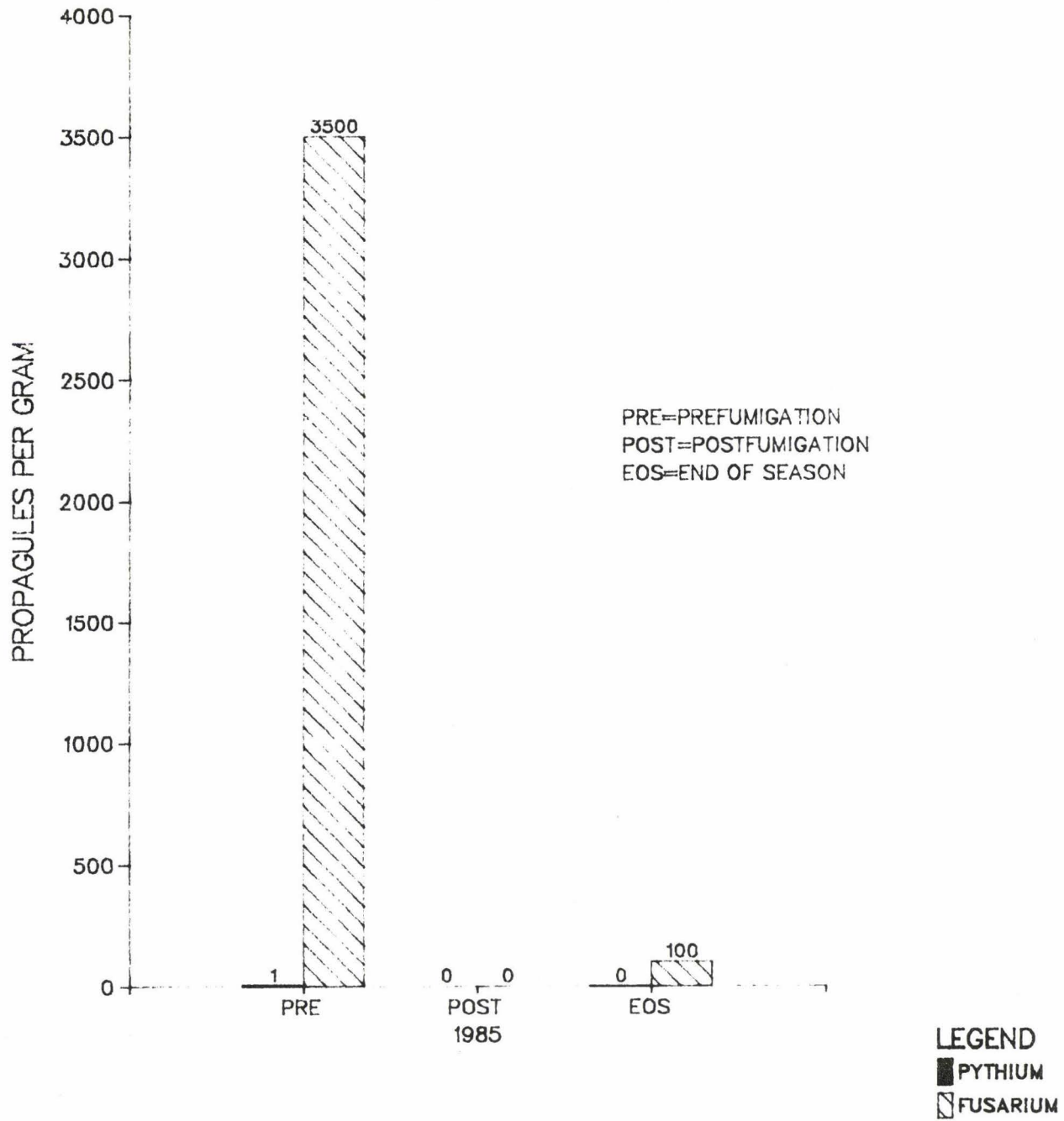
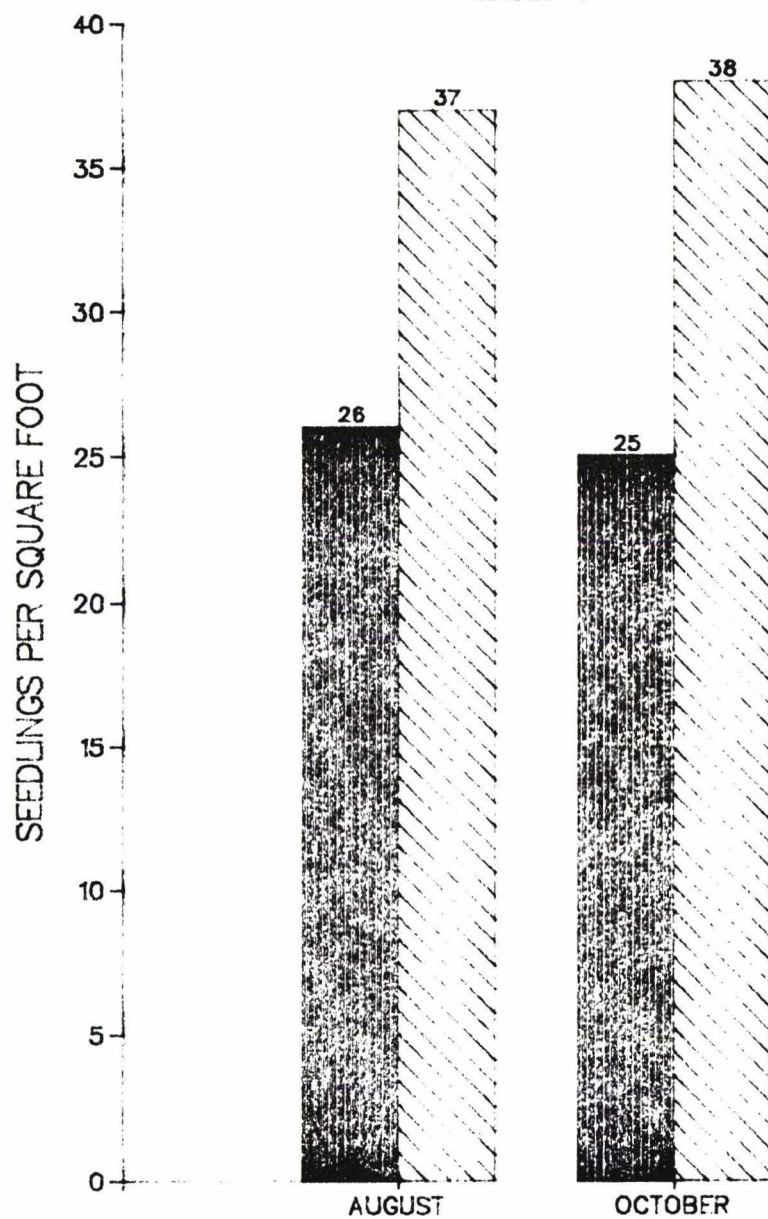


Figure 3. MEAN TREE DENSITIES
AT THE ALBUQUERQUE TREE NURSERY

Block 7



LEGEND

- UNFUMIGATED
- FUMIGATED SOILS

Figure 4. MEAN TREE DENSITIES
AT THE ALBUQUERQUE TREE NURSERY

Block 8

